

## Some precisions on the use of the term *playa* in the geologic literature

### Algunas precisiones sobre el uso del término *playa* en la bibliografía geológica

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#### Abstract

The term *playa* has been used in the geomorphological and sedimentological literature for more than a century, but there is still considerable confusion around its precise definition and the English equivalent or lack of it. A revision of the original descriptions and some recent general papers on this topic shows that the geomorphic approach to its definition, that is, its topography and relationship, or lack of it, to a fluvial network is totally insufficient for its distinction from other continental and coastal sedimentary environments. Subsurface hydrology, evaporite geochemistry and tectonic regime must be considered to constrain the proper use of the term.

**Keywords:** Playa, arid environments, continental evaporites, subsurface hydrology, rift basins

#### Resumen

El término *playa* ha sido utilizado en la bibliografía geomorfológica y sedimentológica desde hace más de un siglo, pero todavía reina una gran confusión sobre su definición precisa y su equivalencia terminológica en inglés (o la falta de la misma). Una revisión de las descripciones originales y de algunos estudios generales recientes demuestra que la aproximación meramente geomórfica a la definición de este término, es decir, su topografía y su relación o no con una red fluvial, es totalmente insuficiente para su distinción de otros medios sedimentarios continentales y marinos. Se debe utilizar su hidrología subterránea, la geoquímica de sus evaporitas y su régimen tectónico para definir con precisión este término.

**Palabras clave:** playa, medios sedimentarios áridos, evaporitas continentales, hidrología subterránea, cuencas rift

#### 1. Introduction

The term *playa* is essential in this issue of the *Journal of Iberian Geology*, but, in spite of some recent attempts to clarify its definition (Rosen, 1994; Briere, 2000), two

fundamental aspects remain controversial: Why this term cannot be translated into English? Are terms like *playa*, *salar*, *dry lake* and *sabkha*, among many others, equivalent? Should regional terms like *chott* or *kavir* be used in the geological literature? These questions will be ad-

dressed in this paper in an attempt to make more precise its use.

## 2. Terminological considerations in Spanish and English

The first problem arises from a terminological confusion. *Playa* is a Spanish word derived from the latin word “*plagia*”. It has two different meanings according to the official Dictionary of Spanish Language (Real Academia Española, 1984): 1.- Sandy linear feature along the sea or river margins, 2.- A flat, open wide space (used in Latin America). Only the second one is relevant for the definition of the sedimentary environment known as *Playa*, because these shallow, dry lakes can have or, more frequently, have not linear beaches along its shores.

The English reference Dictionaries quote the first meaning as “Beach” or “Shore” (Anonymous, 1987; Smith, 1990) but only the latter quotes the second one: “Flat, open space (used in Latin America)”. English-speaking geologists and geomorphologists have traditionally recognized the impossibility of a correct translation of the Spanish term in a single word, hence its general use in Spanish, but they always supposed that only the first meaning existed in Spanish and looked for linear beaches along its shores, which are not present in most cases. Here lies, probably, one of the sources of the reigning terminological confusion, in spite of clear indications that the second and appropriate one was known at least by some English linguists.

The term *Playa* has been used in English geomorphological and sedimentological literature to describe the shallow, dry lakes of many arid and semi-arid regions many times on the false assumption that all of them had well defined coastal linear features (“beaches”), which is not the case in many examples.

A very interesting observation on this topic was made by Gutierrez (2001): the term has been used in America since the Spanish colonisation of SW. USA, Mexico and South America in the XVI century, but it is also used in the Central Ebro Basin, NE Spain, where one of the largest closed, shallow depressions, flooded only during rare storm events, is called “*La Playa*”. As most of the geographic Spanish toponimic names are of medieval origin, this specific one from the semi-arid Central Aragón area was probably exported to America by the Spanish colonists for similar geographic features in the New World. It is worthwhile to mention that the *La Playa* semi-arid lake do not display linear beaches along its shoreline.

Therefore, the English term “*playa*” has nothing to do with linear coastal features (“beach” or “shore”) equiva-

lent to the first meaning of the word in Spanish, but only refers to the second one and cannot (and should not) be translated into English by a single word.

## 3. Geological definition of *playa*

The geographic and geologic literature on arid and semi-arid areas contains many regional terms to describe closed, flat continental shallow depressions flooded occasionally by storms; most of them are listed by Rosen (1994) and the following ones are of relevance in this review:

- Playa (dry lake): USA, México and South America.
- Salar (pure saline dry lake): Chile, Argentina, Bolivia.
- Salina (mixed saline-detrital dry lake) South America.
- Sabkha (salt marsh, usually coastal): Middle East.
- Chott (mixed saline-detrital dry lake) North Africa.
- Barreal (silt-dominated dry lake) Chile, Argentina, Bolivia.

As stated before, the term *playa* was widely used as a geographic term for continental, dry shallow depressions by the Spanish-speaking populations of the huge area between the SW. USA and the northern Argentina-Chile since the XVI century, but, as Neal (1975) points out, the first geomorphological use of this term to describe a landform is obscure.

Gilbert (1875, 1890) used it in a general description of the north-american lakes, but he did not define it. Russell (1883, 1885) used the terms *playa* and *playa lake* as synonymous, associated to “...mud plains derived from ephemeral lake bodies that received markings that are usually considered characteristic of shores.” He, therefore, considered these Spanish term as derived from the *first* meaning of the word in Spanish (see above), but it was very soon discovered that many of his *playas* do not display marginal beach features. The deliberate search for these features is another source of the ensuing terminological confusion.

The geographical terms listed at the beginning of this chapter were used freely as synonymous for these features (and many other regional names in Asia and Australia), regardless of the evaporitic or siliciclastic nature of their sediments, the closed or open nature of its basin drainage nor its tectonic setting and origin.

At this stage, it is important to stress that the original geologic use of the term was, basically *geographic*, to describe a particular variety of topographic depressions.

An important contribution to the understanding of these features was made by Blackwelder (1931), who documented the importance of wind deflation on its origin and evolution, using examples from SW. USA dry lakes.

Sediments deposited during the flooding stages (clay and gypsum) form alternations that are eroded by the wind down 3-4 meters from the original playa surface; some remains of it are found as small tabular hills capped by massive selenite beds.

The absence of river channels or deposits in the lowest parts of the depressions prove that wind is a highly effective erosive agent in deserts. Blackwelder (1931) used the term *playa* only for the central part of enclosed mountain desert basins in SE California.

A first attempt to clarify the use of the term *playa* in a more comprehensive way was made by Neal (1975). He defined it as: "The geological term for the flat and generally barren lower portions of arid basins of internal drainage that periodically flood and accumulate sediments". This is, clearly, a *geomorphological* definition, modified by the author in the same work after his correct observation that not all playas have the same origin and, in many cases are not internally drained, to a more general definition: "a variety of topographic depressions and dessicated lakes that occur in the arid zone". This second definition of *playa* has been widely used for any dessicated, shallow basin, but is so general that do not clearly separates *playa* from other possible equivalents.

He discussed the terms *dry lake* ("shallow lakes that dry out occasionally"), *playa lake* ("the flooded stage of a *playa*") and *sabkha* ("coastal saline flat similar in many respects to interior playas"). He suggests a possible derivation of the word *playa* from the homonymous Spanish word for shore or beach, the common but erroneous assumption of English literature in the subject.

It is clear that his purely *geomorphological* approach to the terminology of shallow, dry arid depressions added little to clarify its correct definition and classification, except for the *marine* character of the *sabkha*, but he made inroads in the correct path pointing out the *climatic* and *hydrologic* controls on its dynamics:

- They must be dry most of the time.
- Their evaporation/precipitation ratio should be higher than 10:1.
- The depth of the watertable and the circulation regime of groundwater are responsible for the capillary discharge in the *playa* surface and the accumulation of surface saline crusts.

He also observed that most of the *playa* basins are *tectonically* controlled, as many of them are found in active rifting areas.

The hydrologic approach was also used by Hardie *et al.* (1978) in a thorough study of the hydrology, geochemistry and sedimentology of continental saline lakes, but they carefully avoid the use of the term *playa* for these sedimentary environments.

Glennie (1978) defined *playa* as "a temporary lake in the centre of a basin of inland drainage where salts are concentrated by evaporation". He correctly stated that not all playas are supplied by surface water as many of them have an important or unique groundwater supply. He correctly considered *inner sabkha* and *playa* as equivalent terms.

Eriksen and Stoertz (1978) defined the related term *salar* as "a salt-encrusted flat or *playa*, specially in Argentina, Chile and Bolivia". Their use of the term for a flat, open area is correct. They characterised the *salar* by geochemical and structural features of the saline crusts at the centre of the basin and proposed that *salar*, *salina*, *salt flat*, *salt pan* and *dry lake* are synonymous terms, a considerable advance in the correct classification of these sedimentary environments.

Renaut and Last (1994) reviewed the saline lake environment in a major collective work, but detailed sedimentological and geochemical studies were not completed by a terminological discussion of the geomorphological terms employed in the work.

A new major review of the term *playa* was made by Rosen (1994) using a simultaneous *geomorphological* and *hydrological* approach and he made very important contributions to the definitive definition of the term. He stated that a *playa* must have the following characteristics:

- To be an *intracontinental* basin.
- The basin must have a *negative* water balance for more than half of the year.
- The capillary fringe of the watertable must be *close enough to the surface* of the *playa* such that evaporation will cause water to discharge to the surface.

The latter observation is crucial in the interpretation of ancient sedimentary sequences, because, if the capillary fringe is too deep during very dry periods (3-4 metres), surface evaporation will not take place and evaporites will be not formed, as it is usually assumed for these periods. Only a hiatus marked by an indurated, mud-cracked surface will be formed in this period.

Rosen (1994) completed his benchmark paper with the novel proposition that the *hydrologic* regime of the *playa* systems is the dominant factor in its formation and evolution, much more that surface morphology, processes or topography. He classified the *playa* systems into two categories:

- Hydrologically open systems.
- Hydrologically closed systems.

In the first category, water can be lost from the *playa* to the underlying aquifer beneath the water table through the basin floor: this is a *recharge playa*, and evaporites cannot be formed by evaporation. These playas are domi-

nated by siliciclastic deposition. If there is only a partial loss of water out of the playa basin at some local areas, a *trough-flow playa* is formed, which may contain minor amounts of evaporites.

In the second category, as water is not lost out of the basin and regional groundwater discharge to the playa system is more or less constant, a *discharge playa* is formed and major amounts of evaporites can accumulate, specially if tectonic subsidence is active in the area.

A short but precise review of the playa systems by Briere (2000) proposes precise definitions for three terms:

- *Playa*: “An intracontinental arid zone basin with negative water balance for over half of each year, dry for over 75% of the time, with a capillary fringe close enough to the surface such that evaporation will cause water to discharge, usually resulting in evaporites”.

- *Playa lake*: “An arid zone feature transitional between playa and lake, neither dry more than 75% of the time nor wet more than 75% of the time”. The Spanish term *barreal* is equivalent to this definition, but it has not been used in international literature and should be avoided in geological studies. When dry, the basin qualifies as *playa*.

- *Sabkha*: “A marginal marine mudflat where displacive and replacive evaporite minerals form in the capillary zone above the saline water table”. Dominant gypsum and anhydrite laminae are typical of this sedimentary environment, due to preferential dissolution of halite during periodic flood events in the local tidal cycle. This latter definition excludes all continental settings, either saline or not.

Finally, particular attention is needed to the definition and use of the related term *sabkha*. It is an Arabic term for “saline flats”, originally applied to both coastal and interior flats. Some authors (i.e.: Kinsman, 1969; Kinsman and Fairbridge, 1978) consider this term equivalent to *playa*, *salar*, *chott* and *salt pan* among others. Warren (1989) followed this criteria and defined *Sabkha* as: “continental and marine mudflats where displacive and replacive evaporites are formed in the capillary zone”. This definition is confuse because it can be applied to many marine and continental arid sedimentary environments.

The first sedimentological use of the term in a very precise way was made in the coastal salt flats of the Arabian Margin of the Persian Gulf (Wells, 1962; Curtis *et al.*, 1964; Evans *et al.*, 1964; Shearman, 1966; Kinsman 1969, among others), where the intertidal zone sedimentation is dominated by characteristic alternations of early diagenetic dolomite, anhydrite, gypsum, halite and magnesite. The hydrologic system is recharged by marine water during tidal cycles and coastal storms. The resulting

sedimentary sequences are very different from those in continental saline environments, as demonstrated by Castens-Seidel (1984); they are almost devoid of halite because regular marine flooding dissolves this mineral and preserve gypsum and anhydrite, some of it as a detrital fraction. The variety of evaporite minerals in continental sedimentary environments is much higher than in the marine ones.

Smoot and Castens-Seidel (1994) completed this crucial *sedimentological* approach by a detailed description of the sedimentary structures produced in the shallow continental saline lakes of SE California, some of them clearly diagnostic of this particular environment.

In order to clarify the nomenclature, it is recommended here to *restrict* the term *sabkha* to *coastal* saline flats, in the spirit of the first precise geological descriptions of the Persian Gulf complexes.

#### 4. Conclusions

The review of the geological literature on playas demonstrates that they cannot be properly identified and defined by a single criteria. Continental and marine shallow, dry depressions and their sediments can be differentiated by combined geomorphological, hydrological, mineralogical and sedimentological criteria.

The term *playa* should be employed for *continental* basins and the term *sabkha* should be reserved for *marine* saline flats in arid shorelines. The term *playa* was used correctly in the XIX century and it should have prelation on other possible synonymous terms.

Among the continental basins, a *rechargeable playa* will be dominated by fine-grained siliciclastic sediments, as evaporites cannot form because water will not evaporate near the surface of the playa and the dissolved cations will be flushed away along the aquifer.

Minor amounts of evaporites can be formed in a *trough-flow playa*, which loses part of the water in the system by local groundwater discharge. These two types are closed hydrologic systems and the term *playa* should be applied only to them. A *playa lake* will represent the inundated period of a *playa* and therefore is no synonymous with it.

Hydrologically-open systems will form a *discharge playa* where substantial amounts of evaporates can accumulate under active subsidence. The term *salar* is recommended here for these basins because of its specificity.

Regional terms should be used only as initial geographical descriptions in both modern and ancient cases.

The term *sabkha* should be restricted to coastal saline flats with specific sedimentary sequences and evaporite mineralogy.



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